GE Oil & Gas

Masoneilan*

77000 Series

High Pressure Labyrinth Trim Control Valves

Integrated Smart Engineered
Best Fit Solutions

- Engineering Expertise
- Leading Technology
- Longer Service Life

imagination at work

77000 Series: High-Pressure Labyrinth Trim Control Valve

GE's Masoneilan 77000 Series axial flow, labyrinth trim control valve combines decades of engineering expertise with leading technology and in-depth customer application knowledge. With a multi-stage, expanding area flow passage, the 77000 Series valve is designed to effectively handle difficult pressure reduction applications while managing noise and vibration levels that can otherwise severely damage equipment. The result is smoother process flow and longer service life, which not only saves time and money, but also mitigates risks in demanding and crucial applications.

Used across a wide range of process applications, the 77000 Series controls high-pressure compressible fluids without the erosion, vibration and high noise levels associated with conventionally designed control valves. The 77000 Series is also particularly well-suited for service applications involving two-phase flow for either gas with entrained liquids/solids or liquids with entrained solids. From upstream oil and gas production to downstream refining and petrochemical processing to some of the most severe steam applications in power generation, the 77000 Series valve stands up to intense temperatures and high pressures.

Customer Benefits

- Cost savings
- Improved process control
- Increased uptime
- Longer service life
- Maintenance simplicity
- Risk mitigation

Industries and Applications

UPSTREAM OIL AND GAS

High pressure, erosive-choke applications
Steam injection for tar sand oil extraction

DOWNSTREAM OIL AND GAS:
Refining and Petrochemical

High-pressure process control applications
Hot, high pressure separation
Delayed coker letdown
PTA crystallizer blow down

POWER GENERATION

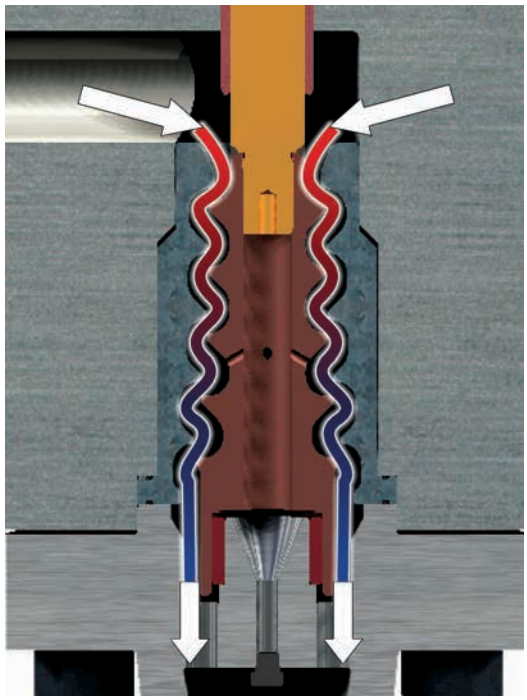
Superheater bypass
Boiler blowdown

Proven Control Through Advanced Design

Multi-Stage, Expanding Area Pressure Reduction

Using proven principles of energy management technology, the 77000 Series gradually reduces fluid pressure, yielding dramatically reduced noise and vibration. The product features a multi-stage trim design that creates flow path friction to simulate the gradual pressure loss that occurs over long pipelines. This effect is produced by passing the fluid through a tortuous flow pattern with multiple restrictions, referred to as pressure reduction stages. Consequently, energy is dissipated through high head loss without undesirable shock waves.

By reducing fluid velocity throughout the throttling process, the 77000 Series' advanced design eliminates the damaging erosive effects caused by high kinetic energy spikes and vibration. The unique flow area of the 77000 Series trim gradually increases at successive trim stages and offers an enlarged outlet connection. The expanded flow areas are designed to compensate for the change in gas density resulting from pressure reduction, thus making the 77000 Series well-suited for high-pressure-drop off-gassing applications. With more than 30 years of installed experience, the Masoneilan 77000 Series has performed successfully in some of the most extreme high-pressure-drop environments. The 77000 Series' advanced design results in minimized fluid velocity, which reduces erosion damage to the trim and downstream process equipment, particularly in applications—such as wellhead chokes in the oil and gas industry—that include particulate in the flow stream. Additionally, the 77000 Series' low velocity outlet area minimizes phase transformation process effects. That is an advantage for many applications that experience flashing or hydrate service conditions, such as startup valves in supercritical power plants, hot high-pressure separator letdown valves in refineries, and gas injection valves in gas extraction plants.

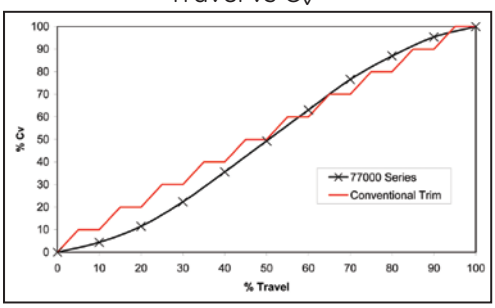


Engineered Features

Axial Flow, Unison Throttling

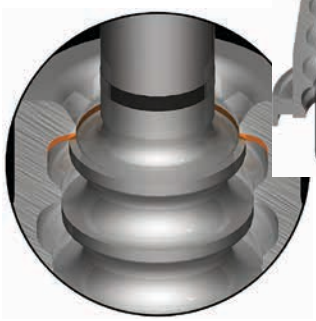
The 77000 Series design separates itself from more conventional pressure-reducing valves by nature of its multi-stage axial flow path design. Unlike radial flow path designs, the 77000 Series throttles the fluid across successively larger stages along the axis of the valve plug. With up to nine separate stages, the control valve positions each stage so that they all operate in unison as the plug strokes, ensuring that the fluid energy is managed in a controlled manner to avoid cavitation. This design concept avoids the stair-step performance that can characterize many radial flow path designs. No single stage or radial flow path trim can match the performance of the 77000 Series.

Travel vs C_V

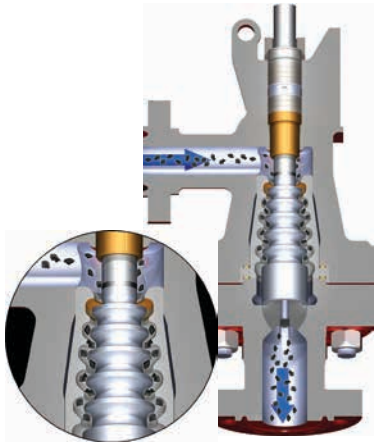


Tight Shutoff, Upstream Seat, Durable Trim Design

Seat protection in a high-pressure valve design is critical to prevent premature seat wear leading to unwanted and undetected leakage. A damaged valve seat can lead to wire drawing and eventually to rapid trim damage from cavitation or flashing when the valve is in the closed position. Seat damage effects are minimized in the 77000 Series by locating the seat on the upstream section of the trim. This design feature ensures that the seat is isolated from the most severe and potentially damaging pressure-reduction stages, which are located in the downstream section of the trim.



Unbalanced, Flow-to-Open Design



The 77000 Series employs a simple unbalanced plug design that eliminates any secondary leak paths that could compromise shutoff integrity. The resulting high-actuator loads are managed by using an offset actuator where loading forces are multiplied by the actuator lever arm. The flow-to-open trim orientation can be useful for applications where service conditions warrant a reliable failure mode.

Trash-Tolerant, Robust Design

The 77000 Series provides large flow paths that allow for the passage of flow-entrained particulate, which can clog conventional drilled-hole or stacked-disk trim. The smooth axial flow path allows particulate to move through the valve without navigating complex trim geometry. This prevents plugging and galling of the trim, which can lead to loss of capacity or premature valve failure. The 77000 Series has a proven track record in many high-pressure, dirty-service applications where a robust valve design delivers essential reliability.

Flexible Platform, Ease-of-Maintenance

The 77000 Series design comes in two styles for easy trim access in the field. A bottom-loaded, flanged-end connection is ideal for process plants, while a top-loaded, butt-weld end design works well in high- pressure power applications. Both styles offer flex- ibility and simple field maintenance for reduced service complexity and cost.

Oil & Gas

UPSTREAM

A staple in the oil and gas Industry for high-pressure-letdown process control, the 77000 Series has solved a variety of severe-service challenges throughout the industry. The 77000 Series' compact design is ideal for high-pressure, erosive-choke applications in wellheads. It has solved many challenges associated with controlling high-pressure letdown involving dirty fluids.

High-Pressure Choke Valves

The 77000 Series choke valve has hundreds of world-wide installations with more than 30 years of successful service life in active wells—some with pressures exceeding 300 Bar and startup conditions in excess of 400 Bar. Designed with a progressively expanding trim, the 77000 Series stages pressure reduction with the smallest pressure drop at the final stage, which is the point where the pressure approaches or drops below the fluid vapor pressure. This minimizes the damaging effects of flashing, cavitation, and gas icing (hydrates). These benefits also make the 77000 Series an ideal solution for injection and extraction at underground gas storage facilities.

The 77000 Series choke valve is available with three interchangeable trim designs for each valve size (Trims A, B and C). Each incremental trim designation features less flow restriction and thus higher capacity. These flexible options adapt to pressure decreases over the course of a well's life. During initial implementation, the 77000 Series offers higher resistance and staging to minimize the effects of high-pressure reduction in new wells. Later, as the pressure gradually drops, the valve can be easily retrofitted with a trim configuration that provides less restriction.

In addition to trim flexibility, the 77000 Series is also available with hardened materials such as boronized stainless steel trim and stellite-clad bodies to provide superior resistance to entrained solids within the flow stream. The result is minimal field maintenance. In addition, the trim's area expansion further reduces the fluid velocity, thus limiting the erosive effects where the particulate in the fluid stream interacts with the valve trim.

Another advantage of the 77000 Series in high- pressure choke applications is its compact mount- ing. A lever arm design amplifies the force of the off-set actuator and minimizes the installation size for space-saving, lightweight implementation on offshore platforms. Additionally, the off-set actuator can be inverted, which reduces the overall height of the assembly so that the valve can be installed and accessed in the tight spaces between platform decks.

For sour service applications, the 77000 Series design can be configured with several designs for tight fugi- tive emissions regulations, including packing designs qualified to ISO 15848 specifications.

Steam Generation for SAGD

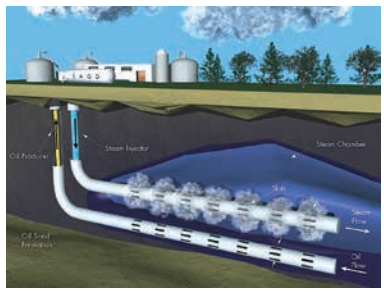
Many of today's oil fields are in regions that have a more dense oil product called bitumen—commonly referred to as tar sands. This heavier product is more difficult to extract and process through traditional methods. Recovery techniques often require the injection of steam into the bitumen to reduce the oil viscosity and allow the oil to flow more freely—a process that requires extremely rugged valves.

Available in durable, high-temperature materials, the 77000 Series serves as a reliable steam injection valve that offers high performance and long service life. As the pressure in the well varies, the 77000 Series can provide the necessary range of differential pressure drop via the staged trim design. Further, the valve is designed to handle two-phase flow in cases where steam and condensate are mixed. Under these conditions, the 77000 Series can prevent trim damage caused by condensate flashing as it changes phase.

With its rugged design, the 77000 Series serves as a reliable control valve that offers high performance and lower cost of ownership. Whether the application is for a steam generator startup system or for the steam injection system, the 77000 Series is well-suited to handle the erosive effects of wet steam under high- pressure-drop conditions.

Depressurizing Valves

The 77000 Series design is well-suited for depressurizing valve applications in gas production facilities. The pressure reduction from the high- pressure gas line to the low-pressure flare header poses some application challenges such as noise with associated vibration, leakage, and hydrate formation. For this service, the 77000 Series features a trash-tolerant trim design with multi-stage pressure reduction for noise and hydrate control, and an unbalanced plug for Class V or MSS SP-61 shutoff.



Oil & Gas

DOWNSTREAM
Refining

Continued global demand for improved production yields, reduced pollutants, and increased plant effi- ciencies has led to the use of the latest technology in refining and petrochemical processes. The 77000 Series valve, with its unique features and rugged design, is a leading technology platform that helps users meet these demanding requirements.

Some of the most advanced refinery units in the industry are those associated with hydroprocessing. The processes of hydrocracking, hydrotreating, resid- hydrocracking, and catalytic dewaxing can improve production yields from lower grade feedstocks while also removing the damaging pollutants that would prevent compliance with ever-increasing environmental standards for fuels. These processes include critical applications where control valves require a combination of high-pressure letdown with cavitation prevention, passing of entrained solids, and handling of multi-phase flow.

Well-proven in these environments for more than 30 years, the 77000 Series offers industry-leading technology to handle the most difficult of applications in a reliable and safe package. The unique combination of attributes of the 77000 Series has led to its endorsement by many worldwide process technology owners and licensors. It is common to see the 77000 Series design specified by name in technical specifications for industry-leading processes.

Hot High-Pressure Separator Valves

The combination of high-pressure reduction and high tempera- tures, along with entrained gases and corrosive agents, makes this application one of the most demanding processes in the refinery. Operators require a control valve that can withstand both erosion and corrosion, as well as a severe-service valve that can manage high-pressure drops without the adverse effects of noise, cavitation, and vibration.

An advantage of the 77000 Series' expanding area trim and wider outlet design is the proper handling of flashing/ off-gassing as the pressure is reduced and the fluid rapidly expands in the valve outlet. The staged gas expansion, coupled with the continuous plug guiding, minimizes vibration levels while providing smooth control.

Available in stainless steels and advanced alloys, the 77000 Series valve offers long-term resistance to corrosive fluids. In addition, the 77000 Series' enlarged flow passages prevent clogging caused by catalyst carryover, while preventing chok- ing due to expansion of entrained gases. For a more robust design and long-term wear protection, material options include valve trim that is hardened by advanced material treatments and hard-facing techniques.

PTA Crystallizer Blow Down Valves

Crystallizer blow down processes are highly demanding petrochemical plant applications. As high-pressure steam is let down to atmospheric conditions, the intense pressure drop can lead to high noise and vibration. Unlike other steam vent applications, this process typically includes particle carryover that can clog the small holes employed to reduce noise in traditional control valves.

The 77000 Series' multi-stage energy management trim and expanding area design deliver advanced noise and vibration reduction without the need for small holes. Additionally, the large flow path technology keeps the fluid moving smoothly through the valve without clogging.

GE is committed to minimizing the impact of our operations and products on the environment through resource conservation, pollution prevention, environmental protection, and product innovation.

Power

The 77000 Series can be used in many severe power- industry applications with demanding temperature and pressure conditions. The 77000 Series valve's advanced engineering and proven long service life make it a solid choice in tough environments.

Startup Bypass Valves

The startup procedures of a supercritical power plant can be extremely severe as the process fluid transitions from a liquid water phase to a supercritical steam phase. Operating conditions fluctuate dramatically throughout the process, from cavitation and flashing occurring at startup, to higher-pressure liquid and steam as the load builds, and finally to superheated steam that can produce high noise levels and vibration. The 77000 Series valve is designed to handle the many levels of severe-service criteria created by the superheater bypass process.

With its unique combination of angled-body, multi- stage energy management technology and expanding area trim, the 77000 Series delivers the right combination of features to serve as the startup valves, also commonly referred to as the BW-202, BW-207 and BE valves in licensed boiler specifications. The expanding area trim allows flashing fluids to safely expand without causing trim damage by managing the fluid pressure drop when outlet conditions are below the vapor pressure. The multi-stage trim also enables the valve to safely eliminate cavitation of high-pressure hot water at startup and attenuate the noise of high- pressure superheated steam at low boiler loads.

To maximize plant efficiency, the 77000 Series assures shutoff integrity through the use of a true unbalanced plug design. For additional reliability, the seating areas are safely located away from the final pressure drop stage. Shutoff integrity permits maximum utilization of the steam through the turbine instead of steam leakage to a downstream tank where the steam energy is lost.

Boiler Blow Down Valves

The 77000 Series offers exceptional service in both continuous and intermittent boiler blowdown applications—crucial processes that cannot be jeopardized to prevent loss of flow to the downstream system. The 77000 Series is capable of managing the high-pressure drop and low-noise requirements of blowdown applications while preventing blockage caused by scale in the pipeline. As a result, the 77000 Series valve can be a valuable part of continuous plant operation, particularly in critical boiler blowdown applications that require system cleanliness and optimal plant operation.

77000 Series Top Entry

Specifications

• Body

Type:	Cast or Forged Angle Style
Sizes:	1" to 8" (expanding outlets available) (DN 25 to 200)
Ratings:	ANSI Class 600 to 4500 API Class 2000 to 15000
End Connections:	RF Flange, RTJ Flange BWE and SWE HUB Connections

• Bonnet

Type:	Bottom Entry, Bolted Outlet Spool Top Entry, Bolted Bonnet

• Body and Bonnet

Materials:	Carbon Steel Stainless Steel/Duplex Chrome-Moly

• Trim

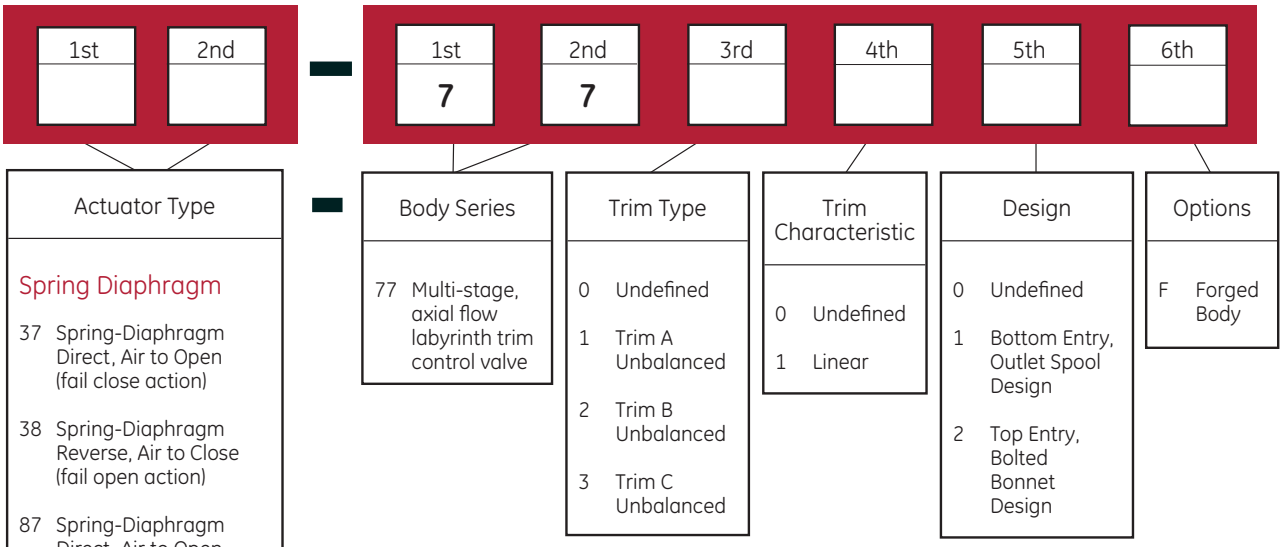
Plug Type:	Multi-Stage Axial Flow (Trim A, B, C Options)
Seat Type:	Metal Seat
Guide:	Top and Bottom Guiding
Cv Ratio:	See Table (page 15)
Flow Characteristic:	Linear

• Actuator

Mounting:	Toggle Arm Mount Direct Mount
Type:	Spring-Diaphragm Spring-Return Cylinder Double-Acting Cylinder Hydraulic & Electric

Optional designs are also available, such as larger sizes, higher pressure ratings, special materials, modified staging, and other configurations as required. Consult the factory for design details and specifications.

Numbering System

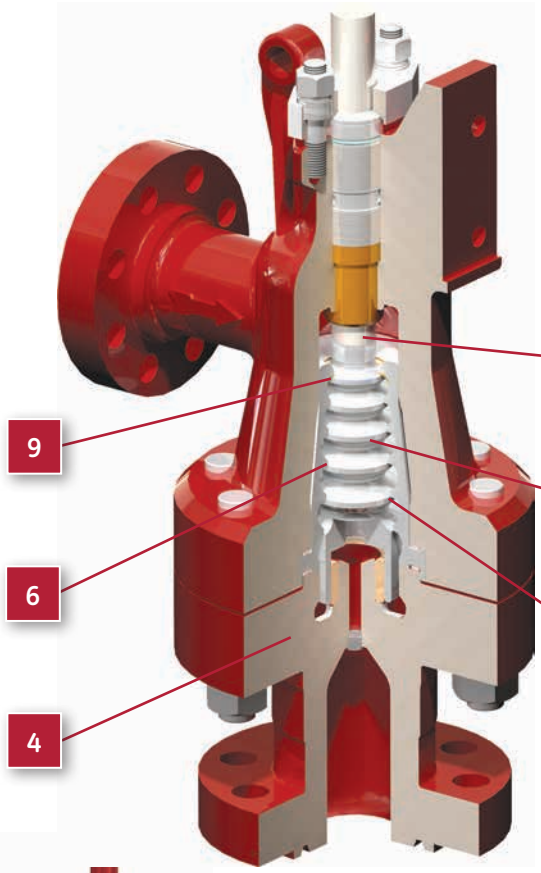

1st
2nd
1st
7
2nd
7
3rd
4th
5th
6th
Actuator Type
Spring Diaphragm
37 Spring-Diaphragm Direct, Air to Open (fail close action)
38 Spring-Diaphragm Reverse, Air to Close (fail open action)
87 Spring-Diaphragm Direct, Air to Open (fail close action)
88 Spring-Diaphragm Reverse, Air to Close (fail open action)
Piston Cylinder
84 Cylinder: spring return, Direct, Air to Open, single or double acting (fail close action)
85 Cylinder: spring return, Reverse Air to Close, single or double acting (fail open action)
86 Cylinder: double acting, without spring, Air to Open or Air to Close action
Body Series
77 Multi-stage, axial flow labyrinth trim control valve
Trim Type
0 Undefined
1 Trim A Unbalanced
2 Trim B Unbalanced
3 Trim C Unbalanced
Trim Characteristic
0 Undefined
1 Linear
Design
0 Undefined
1 Bottom Entry, Outlet Spool Design
2 Top Entry, Bolted Bonnet Design
Options
F Forged Body

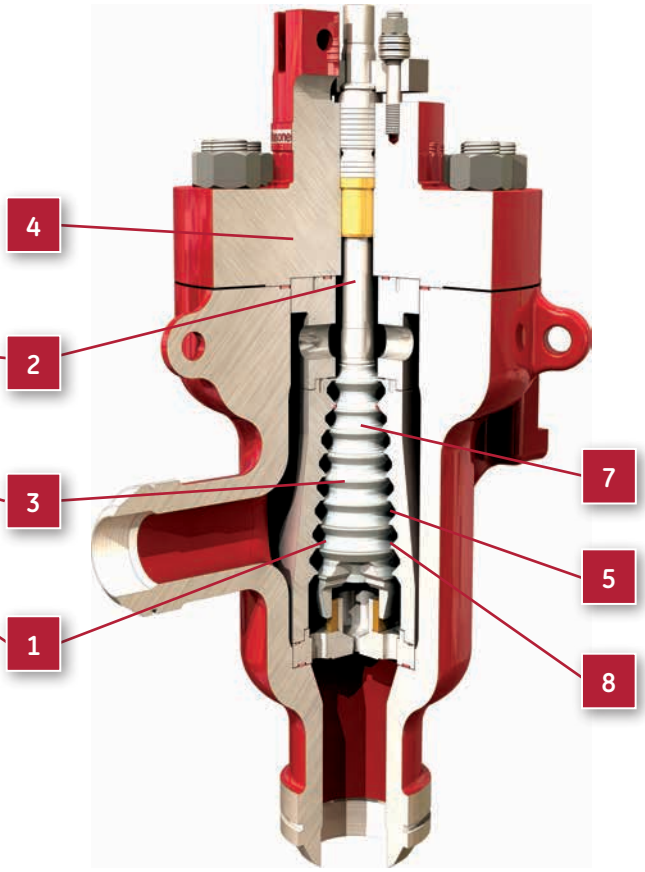
Flow Coefficient (C_V) & Expansion Ratios

Valve Size (inch)	Outlet Options (Inch)	Trim Size					
		A		B		C	
		Expansion Ratio	C_V	Expansion Ratio	C_V	Expansion Ratio	C_V
1	1	4:1	2	2:1	4	1.5:1	6
	2	4:1	2	2:1	4	1.5:1	6
	3	4:1	2	2:1	4	1.5:1	6
2	2	4:1	12	2:1	22	1.5:1	35
	3	4:1	12	2:1	22	1.5:1	35
	4	4:1	12	2:1	22	1.5:1	35
3	3	4:1	31	2:1	45	1.5:1	72
	4	4:1	31	2:1	45	1.5:1	72
	6	4:1	31	2:1	45	1.5:1	72
4	4	4:1	54	2:1	72	1.5:1	110
	6	4:1	54	2:1	72	1.5:1	110
	8	4:1	54	2:1	72	1.5:1	110
6	6	4:1	72	2:1	120	1.5:1	170
	8	4:1	72	2:1	120	1.5:1	170
	10	4:1	72	2:1	120	1.5:1	170
8	8	4:1	120	2:1	180	1.5:1	260
	10	4:1	120	2:1	180	1.5:1	260
	12	4:1	120	2:1	180	1.5:1	260

* Note: Special designs with oversized and reduced C_V trim are available. Please consult the factory.

Features & Benefits

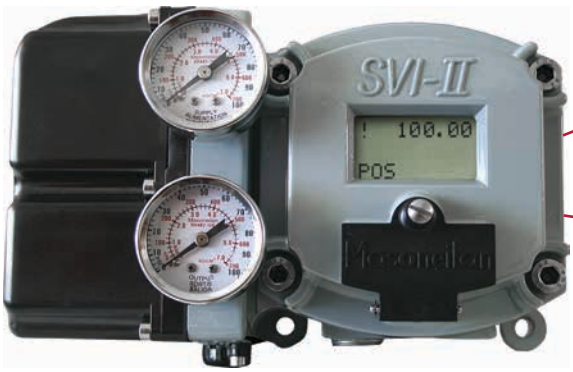




77000 Series Bottom Entry

77000 Series Top Entry

High Performance Actuation



SVI® II AP
Digital Positioner

	FEATURE	ADVANTAGE	END USER BENEFIT	
1	Multi-stage Trim	Cavitation Elimination and Noise Reduction	Longer Installed Trim Life	Cost Reduction
2	Robust One-Piece Plug Stem Design	Trim Durability	Longer Installed Trim Life	
3	Various Trim Resistance Designs	Flexible Design for Multiple Trim Capacities	Reduced Capital Spending	
4	Flexible Trim Access Designs	Ease of Installation and Maintenance	Reduced Downtime	
5	Expanding Area Trim	Velocity Control and Noise Reduction	Decrease Trim Erosion Caused by Particles in Flow Stream	Risk Management
6	Axial Flow Technology	Trim Stability and Protection	Eliminates Direct Impingement and Reduces Trim Wear	
7	High Resistance Tortuous Flow Path	Effective Fluid Energy Management	Minimizes Damage Induced by System Noise and Vibration	
8	Large Flow Passages	Trash Tolerance	Improves Uptime for Dirty Fluid Applications	
9	Seat Location Upstream of Flow Restriction	Long-Term, Reliable Tight Shutoff	Prevent Loss of Product and Trim Damage	Revenue Enhancement
10	SVI II AP or FVP Positioner	Optimized Control Performance	Precise Control of Process	
11	ValVue On-line Valve Diagnostics	Remote Real Time Monitoring of Operating Performance	Eliminate Unscheduled Outages	
12	High Performance Actuation	Trim Stability and Control Reliability	Repeatable Control of Process	

Customer for Life

To provide comprehensive local support, GE maintains a global network of fully authorized repair and service centers, MARC®s. GE and our Masoneilan Authorized Repair Centers are driven by a "Customer for Life" philosophy that manifests itself through a comprehensive suite of aftermarket services including OEM rapid parts, onsite diagnostics, service, and repair. The service offerings from GE span all phases of the equipment life cycle, from engineering to startup and through operation and maintenance:

- Technical support from custom design to applications engineering
- Support of installation, setup and commissioning
- Products with best-in-class control performance
- Diagnostic tools that can support process control optimization objectives
- Tools providing the intelligence necessary for preventive maintenance

Severe-Service Innovation

Severe-service valve design innovation at GE is evidenced by the extensive portfolio of field-proven engineered products we provide for the most severe process control applications. Indeed, GE's Masoneilan control valve portfolio has long served as the benchmark for severe service innovation in industries such as power generation, oil and gas production and LNG. These industries are home to many of the toughest control valve applications, particularly those involving large-mass flow rate and high- differential pressure such as compressor anti-surge, high-pressure vents, and turbine bypass.

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